

TEAC FD-235HG-U000
USB INTERFACE MICRO FLOPPY DISK DRIVE

HARDWARE SPECIFICATION

Rev. A

29 sheets in Total

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1. GENERAL

This is the hardware specification of the TEAC FD-235U, 90mm (3.5-inch) double-sided 5.3-track/mm (135-tpi) micro floppy disk drive (hereinafter referred to as FD-235U) with a data capacity of 1.44MB/1.2MB/720KB (formatted) and a USB interface board.

(Table 1.-1) Specification outline

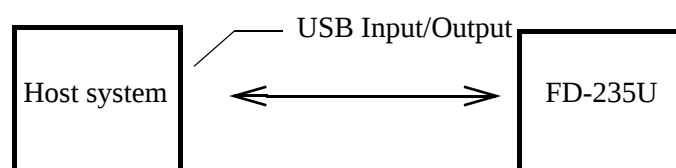
Model name		FD-235HG-U000		
DELL P/N		WJN2K		
Hardware Rev.		A00		
TEAC P/N		193077U0-00		
Operation mode		720KB mode, write/ read	1.2MB mode, write/ read	1.44KB mode, write/ read
Disk used		Normal density (2DD)	High density (2HD)	High density (2HD)
Data transfer rate	Internal FDD	250k bits/s	500k bits/s	500k bits/s
	USB	Full speed mode (12M bits/sec)		
Disk rotational speed		300rpm	360rpm	300rpm
Track density		5.3 track/mm (135-tpi)		
Required power		+5V single (4.75 ~ 5.25V)		
Front bezel		Black		
Front shutter		Black		
Eject button		Black		
LED indicator color		Green		
Signal interface		USB (Universal Serial Bus): USB Specification Ver.2.0		
Terminator		Provided (at factory), 1.5k $\pm$ 5% (Conforming to the USB Specification Ver.2.0)		
Other optional function		Not equipped		

This FD-235U uses two disks and has three write and read modes with an unformatted data capacity of 1.44M bytes/1.2M bytes/720k bytes, and the interface with the host system is USB. This FD-235U has a switch for the detection of the high-density identification hole (HD hole) in the disk cartridge, and can identify the type of cartridge now loaded in the FD-235U.

2. SYSTEM CONFIGURATION

2.1 System Configuration

The following system configurations are available with the FD-235U.



(Fig. 2.1-1) System configuration

2.2 Disconnection of Connector

The FD-235U should not be disconnected under the following conditions

- (a) During formatting
- (b) During write
- (c) During read

3. DISK

3.1 Work Disk

90mm (3.5-inch) micro floppy disks in Table 3.1-1 which are mutually agreed between the customer and TEAC.

(Table 3.1-1) Disk used

Operation mode	Disk type	Name	Magnetic powder	Magnetizing method
720KB	Normal density	DD	Co- γ -Fe ₂ O ₃	Surface recording
1.2MB/1.44MB	High density	HD	Co- γ -Fe ₂ O ₃	Surface recording

3.2 Cleaning Disk

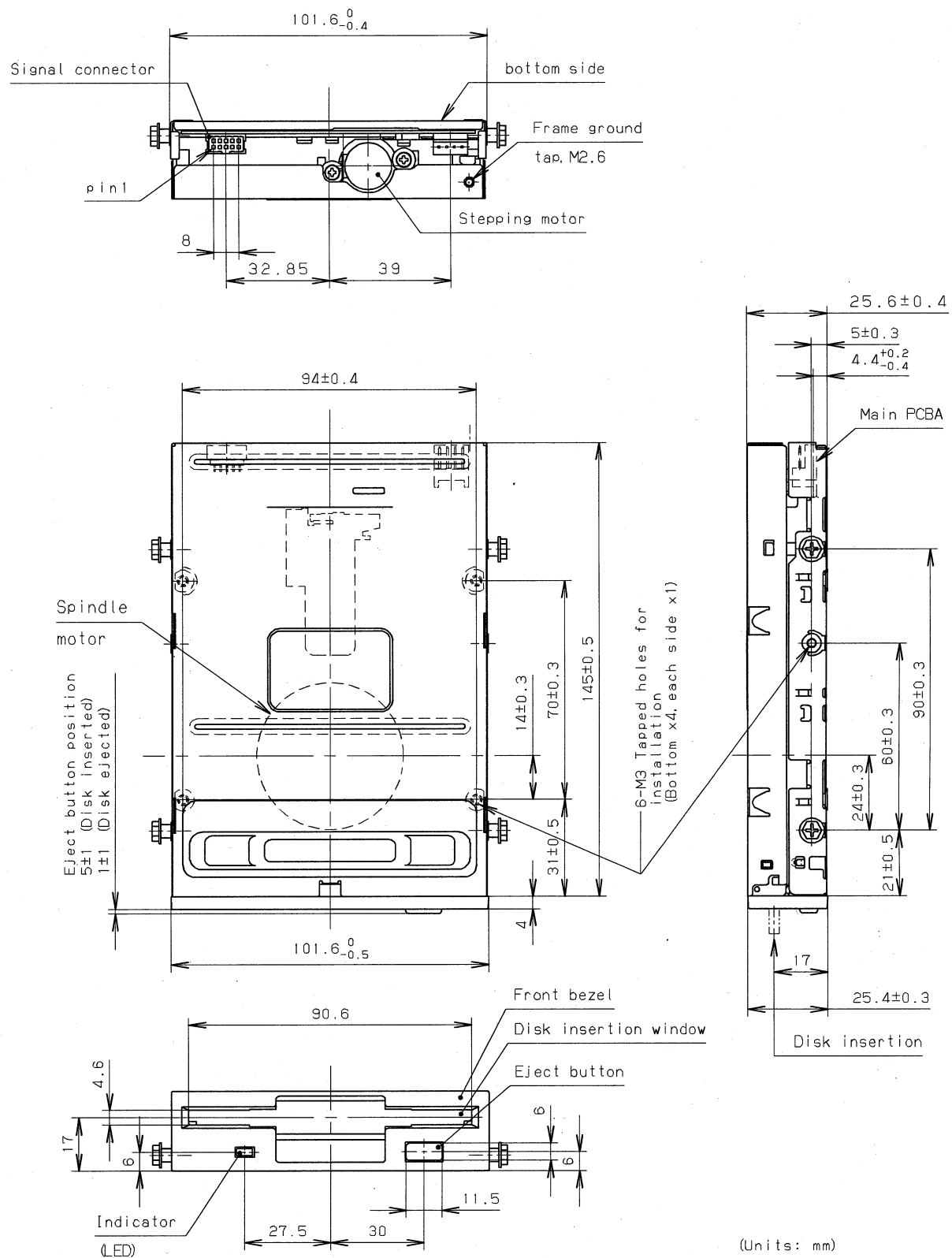
The use of a cleaning disk is not required for the FD-235U. However, if for a compelling reason it has to be used, be sure to use a dry type which is mutually agreed upon between the customer and TEAC.

4. PHYSICAL SPECIFICATIONS

Physical Specifications

(Table 4.-1) Physical specifications

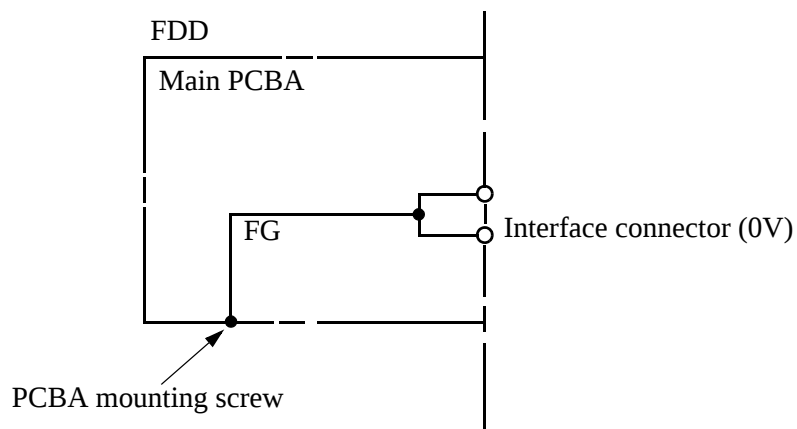
Width	101.6mm (4.00 in), Nom.
Height	25.4mm (1.00 in), Nom.
Depth	145mm (5.71 in), Nom., excluding front bezel
Weight	400g, Nom., 410g, Max.
External view	Refer to Fig. 4.-1
Cooling	Natural air cooling
Mounting	Mountings for the following directions are acceptable. (a) Front loading, mounted vertically. (b) Front loading, mounted horizontally within spindle motor down. (c) The flatness in (a) and (b) shall be with 25° in the direction in which the front bezel side raised (+) or lowered (-). However, the flatness from +25° to horizontal level is allowed when the disk is ejected out of the tray. Note: As to the other mounting directions than the above will be considered separately.
Installation	With installation holes on the frame of the FDD. Refer to Fig. 4.-1 .
Material of frame	Sheet metal
Material of front bezel	PPHOX or ABS (Complying with UL94-5V)



(Fig. 4.-1) External view

4.1 Frame Grounding

The FDD frame is electrically connected to DC 0V by a PCBA mounting screw.



(Fig. 4.1-1) Frame ground internal connection

5. FUNCTIONAL SPECIFICATIONS

5.1 1.44MB Mode Data Capacity

(Table 5.1-1) 1.44MB mode data capacity

Recording method				MFM
Data transfer rate in FDD (k bits/s)				500
Tracks/disk				160
Innermost track bit density (bpmm), Side 1				686.38
Innermost track flux density (fcpmm), Side 1				686.38
Data capacity	Unformatted		k bytes/track	12.50
			k bytes/disk	2,000
	Formatted	18 sectors/track	k bytes/sector	0.512
			k bytes/track	9.216
			k bytes/disk	1,474.56

5.2 1.2MB Mode Data Capacity

(Table 5.2-1) 1.2MB mode data capacity

Recording method			MFM	
Data transfer rate in FDD (k bits/s)			500	
Tracks/disk			160	
Innermost track bit density (bpmm), Side 1			571.97	
Innermost track flux density (fcpmm), Side 1			571.97	
Data capacity	Unformatted		k bytes/track	10.416
			k bytes/disk	1,666.56
	Formatted	15sectors/track	k bytes/sector	0.512
			k bytes/track	7.680
			k bytes/disk	1,228.80
		8 sectors/track	k bytes/sector	1.024
			k bytes/track	8.192
			k bytes/disk	1,310.72

5.3 720KB Mode Data Capacity

(Table 5.3-1) 720KB mode data capacity

Recording method				MFM
Data transfer rate in FDD (k bits/s)				250
Tracks/disk				160
Innermost track bit density (bpmm), Side 1				8,717
Innermost track flux density (fcpmm), Side 1				8,717
Data capacity	Unformatted		k bytes/track	6.25
			k bytes/disk	1,000
	Formatted	9 sectors/track	k bytes/sector	0.512
			k bytes/track	4.608
			k bytes/disk	737.28

5.4 Disk Rotation Mechanism

(Table 5.4-1) Disk rotation mechanism

Spindle motor		Direct DC brushless motor
Spindle motor speed		300rpm/360rpm
Motor servo method		Frequency servo by ceramic oscillator
Motor/spindle connection		Motor shaft direct
Disk rotational speed		The same as the spindle speed
Long term speed variation (LSV)		±1.5% or less
Instantaneous speed variation (ISV)		±2% or less
Average latency	1.44MB mode/1.2MB mode	100ms
	720KB mode	83.3ms
Speed change time		480ms (300rpm → 360rpm)

5.5 Index Detection

(Table 5.5-1) Index detection

Number of index		1 per disk revolution
Detection method		Rotor revolution detection of the spindle motor by Hall IC or FG output
Detection cycle	2MB/1MB mode	200ms $\pm$ 1.5%
	1.6MB mode	166.7ms $\pm$ 1.5%
Index burst detection timing error (with specified test disc)	300 rpm	$\pm$ 400 μ s or less
	360 rpm	$\pm$ 340 μ s or less

5.6 Track Construction

(Table 5.6-1) Track construction

Track density (nominal)	5.3 tracks/mm (135tpi) (track pitch 187.5 μ m, nominal)
Number of cylinders	80 cylinders
Number of tracks	160 tracks/disk
Outermost track radius (track 00)	Side 0 39.500mm (1.5551 <i>in</i>)
	Side 1 38.000mm (1.4961 <i>in</i>)
Innermost track radius (track 79)	Side 0 24.6875mm (0.9719 <i>in</i>)
	Side 1 23.1875mm (0.9129 <i>in</i>)
Positioning accuracy	$\pm$ 15 μ m or less, with specified test disk

5.7 Magnetic Head

(Table 5.7-1) Magnetic head

Magnetic head	Read/write head with erase gap, 2 sets
Effective track width after trim erase	0.115 $\pm$ 0.008mm (0.0045 $\pm$ 0.0003 <i>in</i>)
Read/write gap azimuth error	$\pm$ 18' or less, with specified test disk

5.8 Track Seek Mechanism

(Table 5.8-1) Track seek mechanism

Head positioning mechanism	Stepping motor with lead screw
Stepping motor	4-phase, 20 steps per revolution
Stepping motor drive	2 steps per track
Track 00 detection method	Photo-interrupter

5.9 Others

(Table 5.9-1) Others

Head load mechanism	Not equipped (The FDD becomes head load condition whenever a disk is installed.)
File protect mechanism	Detection of write inhibit hole by mechanical switch
Disk detection mechanism	Detection of disk installation by mechanical switch
Disk inserting force	6.86N (700g) or less at the center of a disk
Disk ejecting force	13.73N (1,400g) or less
Acoustic noise at 50cm	50dBA or less at 4ms seek operation
Disk type discriminating mechanism	Detection of HD hole by mechanical switch

6. ENVIRONMENTAL CONDITIONS

(Table 6.-1) Environmental condition

	Operating	Storage	Transportation
Ambient temperature	4 ~ 51.7°C (39 ~ 125°F)	−22 ~ 60°C (−8 ~ 140°F)	−40 ~ 65°C (−40 ~ 149°F)
Temperature gradient	20°C (36°F) or less per hour (no condensation)	30°C (54°F) or less per hour (no condensation)	30°C (54°F) or less per hour (no condensation)
Relative humidity	20 ~ 80% (no condensation) Max. wet bulb temperature shall be 29.4°C (85°F).	5 ~ 90% (no condensation) Max. wet bulb temperature shall be 40°C (104°F).	5 ~ 95% (no condensation) Max. wet bulb temperature shall be 45°C (113°F).
Vibration	14.7m/s ² (1.5G) or less (10 ~ 100Hz, 1octave/min. sweep rate)	—	19.6m/s ² (2G) or less (10 ~ 100Hz, 1/4octave/min. sweep rate)
	9.8m/s ² (1.0G) or less (100 ~ 200Hz, 1octave/min. sweep rate)		
	4.9m/s ² (0.5G) or less (200 ~ 600Hz, 1octave/min. sweep rate)		
Shock	Write & read: 49m/s ² (5G) (11ms, 1/2 sine wave) or less	—	686m/s ² (70G) (11ms, 1/2 sine wave) or less
	Read only: 98m/s ² (10G) (11ms, 1/2 sine wave) or less Soft errors are allowed if they are recoverable within three retries.	—	
Transportation conditions	The above requirements are applied for the FD-235U without shipping box. When a long period for transportation such as by ship, storage environmental conditions should be applied.		

7. RELIABILITY**(Table 7.-1) Reliability**

MTTF		30,000 power on hours or more (for typical usage)
Design component life		5 years
Disk life		3×10^6 passes/track or more
Disk insertion		1.5×10^4 times or more
Seek operation life		1×10^7 random seeks or more
Preventive maintenance		Not required (for typical usage)
Error rate	Soft read error	1 or less per 10^9 bits read A soft (recoverable) error is defined that data can be read correctly within three retries.
	Hard read error	1 or less per 10^{12} bits read A hard (unrecoverable) error is defined that it cannot be read correctly within three retries . However, it is recommended to be followed by a recalibration to track 00 and six additional retries or more.
	Seek error	1 or less per 10^6 seeks A seek error is defined that a target track can be sought within one retry.

8. USB INTERFACE

(Table 8.-1) USB interface connector

FDD side connector	MOLEX 78046-1021 or equivalent
Pin numbers	9 pins (7 pin VOID)
Connector location	Refer to Fig. 4.-1.

(Table 8.-2) USB interface pin-assignment

Contact Number	Signal Name	Comment
1	N.C.	
2	–DATA	
3	+DATA	
4	Ground	
5	N.C.	
6	N.C.	
7	N.C.	Key
8	N.C.	
9	N.C.	
10	N.C.	

9. POWER INTERFACE

9.1 Required Power

The following specifications are applied at interface connector of the FDD.

- (1) DC +12V : Not required
- (2) DC +5V
 - (a) Voltage tolerance : $\pm 5\%$ (4.75 ~ 5.25V)
 - (b) Allowable ripple voltage :100mVp-p or less (including spike noise)
 - (c) Current and power consumption

(Table 9.1-1) Current and power consumption

Operating mode	Average current		Average power	
	Typ.	Max.	Typ.	Max.
Non - Operation	50mA	60mA	250mW	315mW
Read operation	0.30A	0.40A	1.50W	2.20W
Write operation	0.30A	0.40A	1.50W	2.20W
Seek operation (4ms)	0.56A	0.66A	2.80W	3.63W
Seek operation peak	0.9A	1.0A	4.50W	5.50W
Spindle motor start	0.62A	0.70A	3.10W	3.85W

Notes:

1. Values of Typ. current and power are specified at 5.0V, while the values of Max. are at 5.25V (+5%) with a disk of large running torque.
2. Stand-by mode is defined at the stop condition of spindle motor and seek operation.
3. Seek operation peak means the operation during the settling (15ms) after the seek completion.
4. Rush current flows within 150ms after the motor start.
5. Short time peak current except for power-on surge is less than 1.0A.

9.2 Power Interface Connector and Cable

(1) Power interface connector

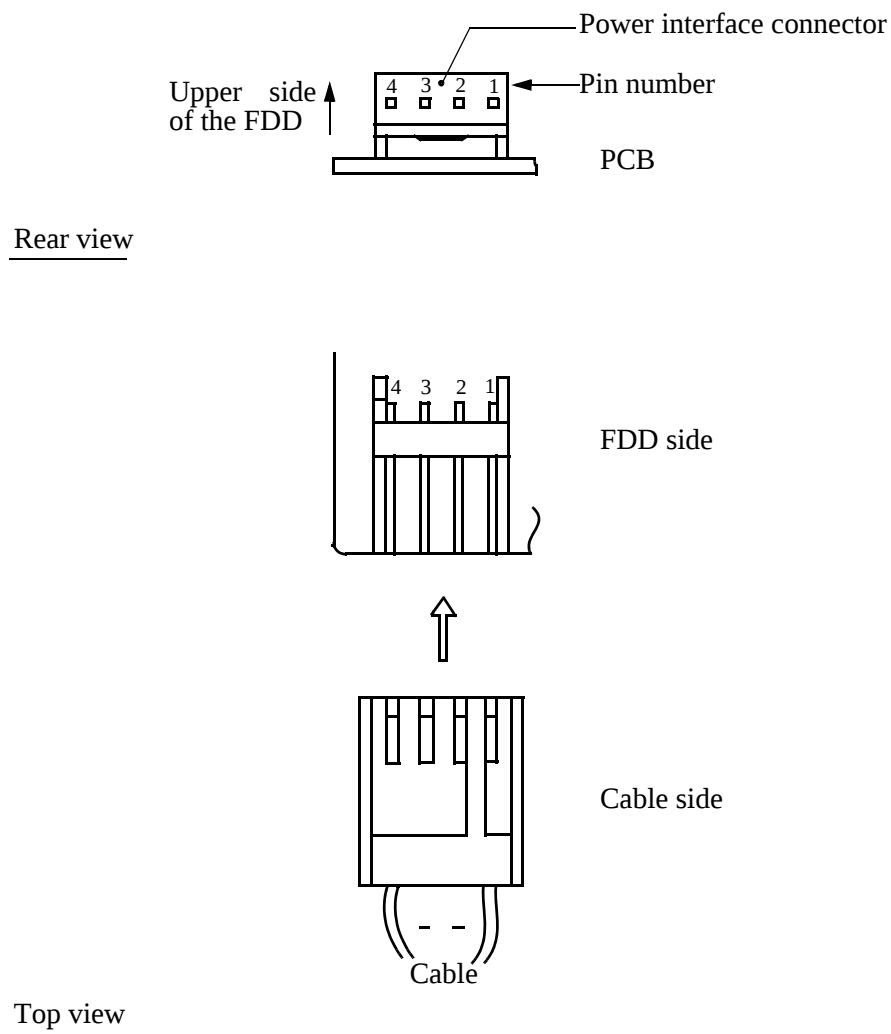
(Table 9.2-1) Power interface connector

FDD side connector	TEKCON, P/N 1603-823-04R-54 or equivalent
Pin numbers	4 pins
Protection method for mis-connection	Mechanical protection by the shape of connector housing
Connector external view	Refer to Fig. 9.2-1.
Connector location	Refer to Fig. 4.-1.
Power interface connections	Refer to Table 9.2-2.
Cable side matched connector	AMP P/N 171822-4 (natural color) or equivalent
Cable side matched pin	AMP P/N 170204-2 (AWG#20 ~ 26, loose piece) or P/N 170262-2 (AWG#20 ~ 26, strip form) or equivalent

- (2) Power interface cable: Any appropriate cables taking the maximum power consumption of the FDD will be acceptable.

(Table 9.2-2) Power interface pin-assignment

Power voltage	Pin numbers
DC +5V	1
0V	2
(0V)	3
(No connection)	4



(Fig. 9.2-1) Power interface connector external view

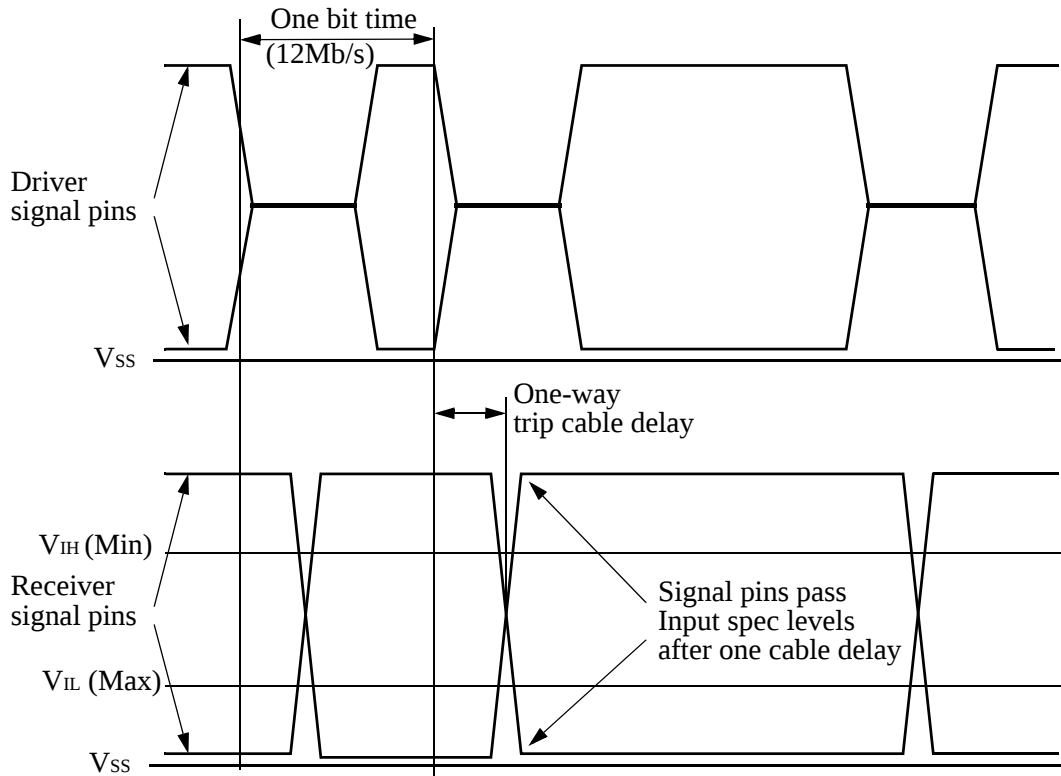
9.3 Signal

9.3.1 Transceiver

- Driver characteristics

Operational output driver is used. (The 3-state operation is supported.)

The driver signal waveforms are given in Fig. 9.3.1-1.

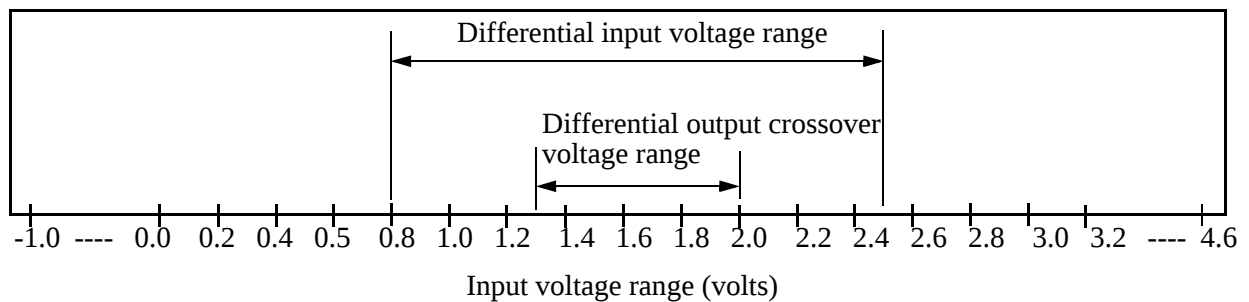


(Fig. 9.3.1-1) Driver signal waveforms

- Receiver characteristics

The differential input receiver is used.

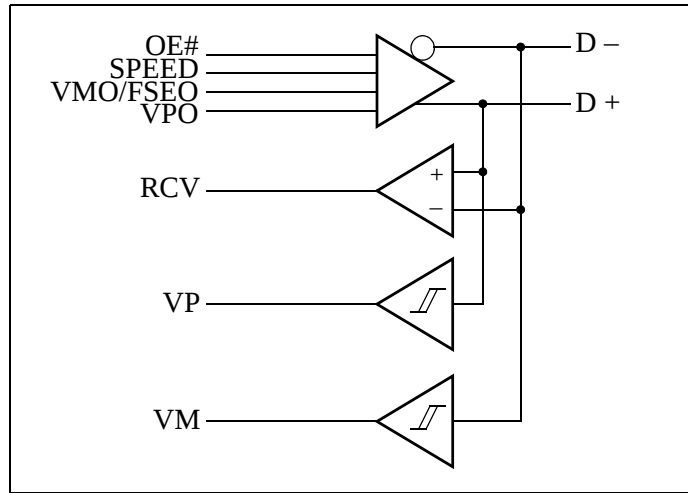
The "common mode input voltage range" where data reception is assured is given in Fig. 9.3.1-2.



(Fig. 9.3.1-2) Differential input sensitivity range

- Transceiver configuration

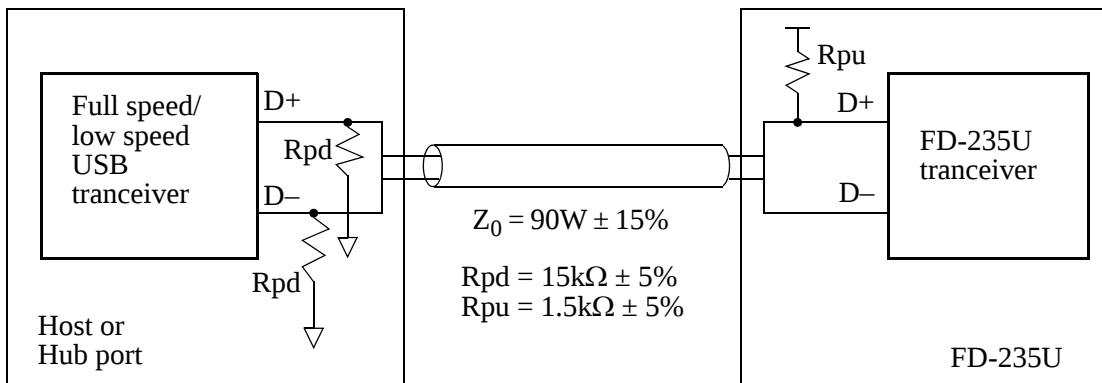
The transceiver configuration is given in Fig. 9.3.1-3.



(Fig. 9.3.1-3) Transceiver configuration

9.3.2 Termination

The signal termination processing diagram of the FD-235U is given in Fig. 9.3.2-1.



(Fig. 9.3.2-1) Signal termination processing

9.3.3 Signaling levels

The signaling levels at each bus state are given in Table 9.3.3-1.

(Table 9.3.3-1) Signaling levels

Bus State	Signaling Levels
Differential "1"	$(D+) - (D-) > 200\text{mV}$ and $D+ > V_{SE} (\text{Min})$ or $D- \rightarrow V_{SE} (\text{Min})$
Differential "0"	$(D+) - (D-) > 200\text{mV}$ and $D+ > V_{SE} (\text{Min})$ or $D- \rightarrow V_{SE} (\text{Min})$
Data J State	Differential "1"
Data K State	Differential "0"
Idle State	Differential "1" and $D+ > V_{SE} (\text{Max})$ and $D- < V_{SE} (\text{Min})$
Resume State	Differential "0" and $D- > V_{SE} (\text{Max})$ and $D+ < V_{SE} (\text{Min})$
State of Packet (SOP)	Data lines switch from Idle to K state.
End of packet (EOP)	$D+ < V_{SE} (\text{Min})$ and $D- < V_{SE} (\text{Min})$ for 2 bit times followed by an Idle for 1 bit time
Reset	$D+ < V_{SE}$ and $D- < V_{SE}$ for $\geq 10\text{ms}$

9.3.4 Suspend/resume

- Suspend

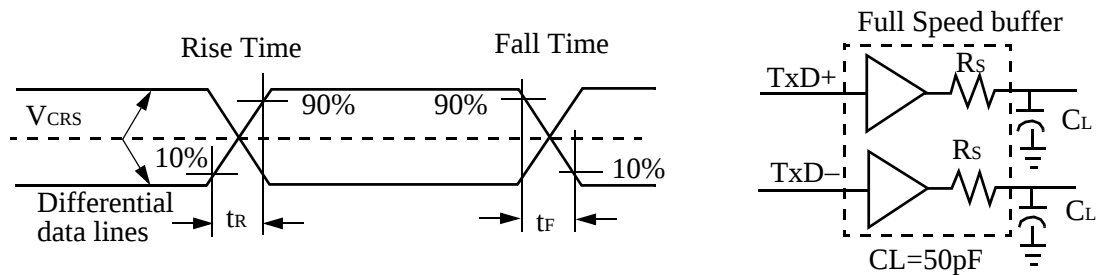
The suspend mode is entered by detecting the idle state continuously for 3.0ms or more on the bus line.

- Resume

Resume is performed by receiving the signal other than idle state on the bus.

9.3.5 Data signal rise and fall time

The FD-235U data signal rise and fall times are given in Fig. 9.3.5-1.



(Fig. 9.3.5-1) Data signal rise and fall times

9.3.6 Jitter

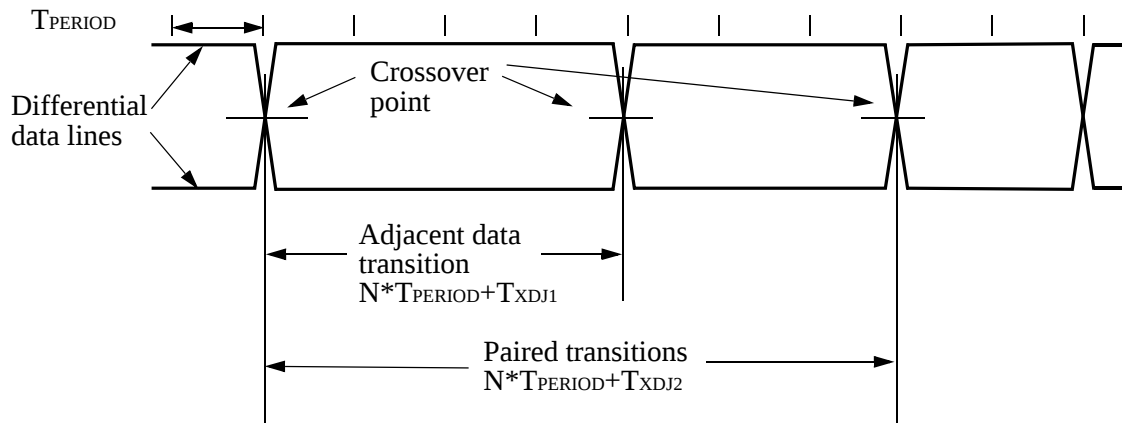
The jitter of the FD-235U is defined below.

The allocation of each jitter source is given in [Table 9.3.6-1](#).

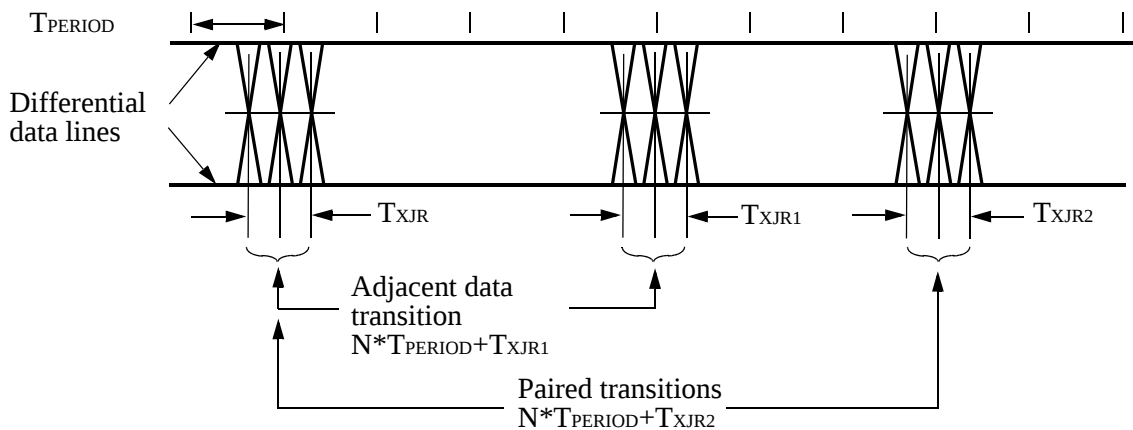
(Table 9.3.6-1) Jitter allocation

Jitter source	Next Transition		Paired Transition	
	Each (ns)	Total (ns)	Each (ns)	Total (ns)
Source driver jitter	2.0	2.0	1.0	1.0
Source frequency error - worst case	0.21/bit	1.5	0.21/bit	3.0
Source jitter total		3.5		4.0
Hub Jitter	3.0	15.0	1.0	5.0
Jitter specification		18.5		9.0
Destination frequency error	0.21/bit	1.5	0.21/bit	3.0
Receiver jitter allocation		20.0		12.0

The FD-235U jitter and jitter range timing waveform are given in [Fig. 9.3.6-1](#) and [Fig. 9.3.6-2](#) respectively.



(Fig. 9.3.6-1) Jitter timing waveform

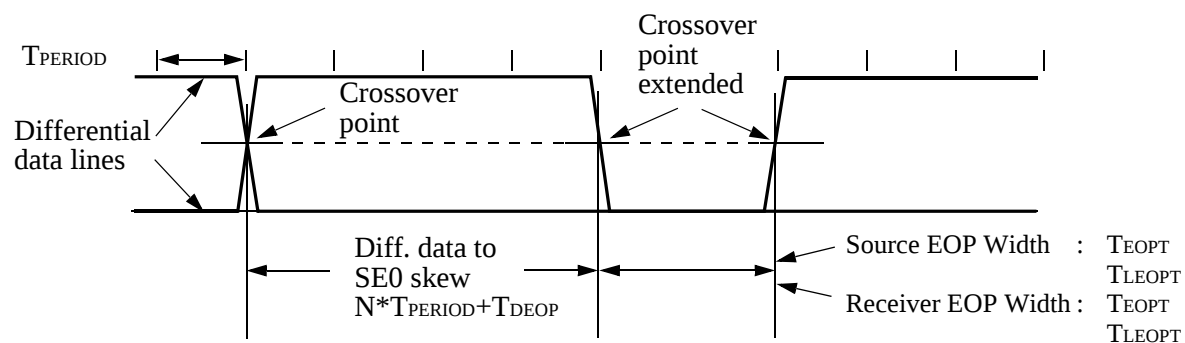


(Fig. 9.3.6-2) Jitter range

9.3.7 Data source EOP

The EOP width of the FD-235U is defined below.

Min: 150ns Max: 175ns



(Fig. 9.3.7-1) EOP width timing

9.4 List of Electrical Characteristics List

(Table 9.4-1) DC electrical characteristics

Parameter		Symbol	Conditions	Min.	(Standard)	Max.	Unit
Input Levels	Differential input sensitivity	V_{DI}	$ (D+) - (D-) $ Refer to Fig. 9.3.5-1.	0.2			V
	Differential common mode range	V_{CM}	Includes V_{DI} range	0.8		2.5	V
	Single ended receiver threshold	V_{SE}		0.8		2.0	V
Output Levels	Static output low	V_{OL}	RL 15k Ω to 3.6V			0.3	V
	Static output high	V_{OH}	RL 1.5 Ω to GND	2.8		3.6	V
Capacitance	Transceiver capacitance	C_{IN}	Pin to GND			20	pF
Terminations	Bus pull-up resistor	R_{PU}	(1.5k Ω $\pm$ 5%)	1.425	1.5k	1.575	Ω

(Table 9.4-2) AC electrical characteristics

Parameter		Symbol	Condition	Min.	(Standard)	Max.	Unit
Driver Characteristics	Rise transition time	T_R	CL = 50pF Refer to Fig. 9.3.5-1.	4		20	ns
	Fall transition time	T_F	CL = 50pF Refer to Fig. 9.3.5-1.	4		20	ns
	Rise/Fall time matching	T_{RFM}	(T_R/T_F)	90	100	110	%
	Output signal crossover voltage	V_{CRS}		1.3		2.0	V
	Driver output resistance	Z_{DRV}	Steady State	28		43	Ω

Parameter		Symbol	Condition	Min.	(Standard)	Max.	Unit
Data Source Timings	Data rate	T _{DRATE}	(12Mb/s = 0.25%)	11.97	12.00	12.03	Mb/s
	Frame interval	T _{FRAME}	1.0ms = 0.05%	0.9995	1.0	1.0005	ms
	Source differential driver jitter To next transition	T _{DJ1}	Fig. 9.3.6-1	−3.5		+3.5	ns
	Source differential driver jitter For paired transition	T _{DJ2}	Fig. 9.3.6-1	−4.0		+4.0	ns
	Differential to EOP transition skew	T _{DEOP}	Fig. 9.3.7-1	−2		+5	ns
	Receiver data jitter To next transition	T _{JR1}	Fig. 9.3.6-2	−18.5		18.5	ns
	Receiver data jitter For paired transition	T _{JR2}	Fig. 9.3.6-2	−9		9	ns
	Receiver EOP width must reject as EOP	T _{EOPR1}	Fig. 9.3.7-1	40			ns
	Receiver EOP width must accept as EOP	T _{EOPR2}	Fig. 9.3.7-1	82			ns

10. PACKAGING

10.1 Packing FDD 30-unit

(Table 10.1-1)

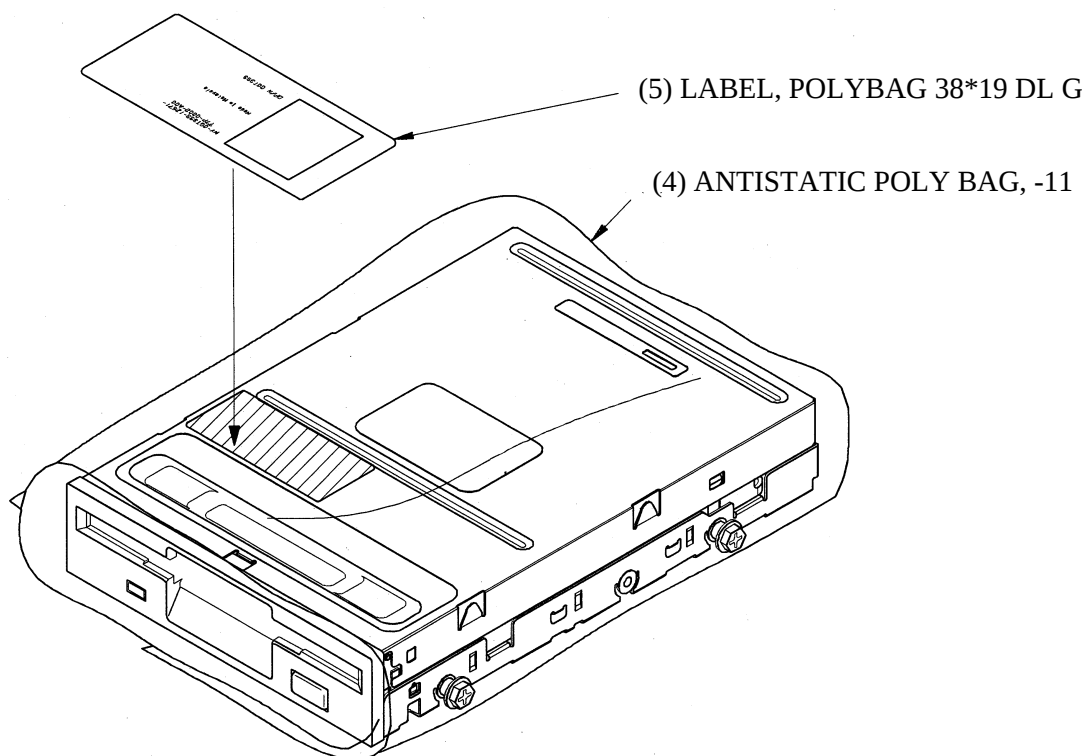
	Individual box
Number of packages	30 units per box
Dimensions	39 × 50 × 26 cm
Volume	0.051m ²
Material of the box	Double-side corrugated cardboard
Material of the cushion	Expanded polystyrene

10.2 List of Packing Materials

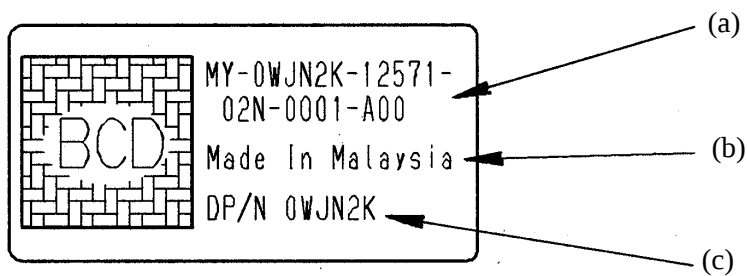
(Table 10.2-1) List of 20-unit packing material

Ref. No.	Part number	Product name	Q'ty	Remarks
(1)	M031411-xxA	CORR CDBD CS, 235C (30) D x	1	
(2)	M028849-00A	CUSHION, U CA400 (30) CHS	1	
(3)	M028848-00A	CUSHION, L CA400 (30) CHS	1	
(4)	10992019-11	ANTISTATIC POLY BAG, -11	30	
(5)	M027270-00A	LABEL, POLYBAG 38*19 DL G	30	
(6)	10022909-01	LABEL, BARCODE (TEAC STD)	2	
(7)	M016380-00A	LABEL, CARTON DEL NEW 3	2	
(8)	14809645	PP TAPE (#40)	Proper quantity	

10.3 LABEL, POLYBAG 38*19 DL G



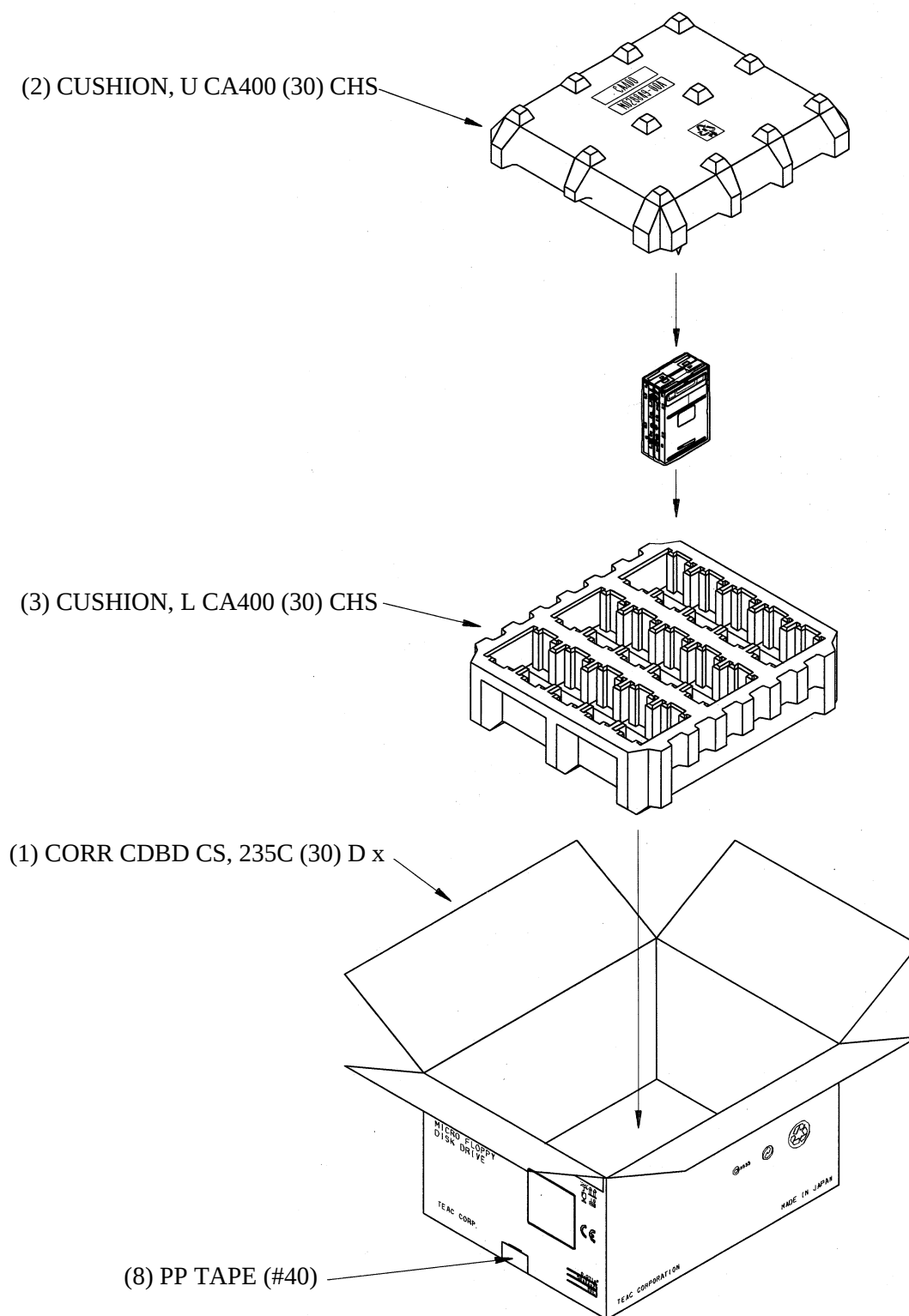
(Fig. 10.3-1) Label attaching position



- (a) Barcode content indication
- (b) Country of origin
- (c) DELL parts number

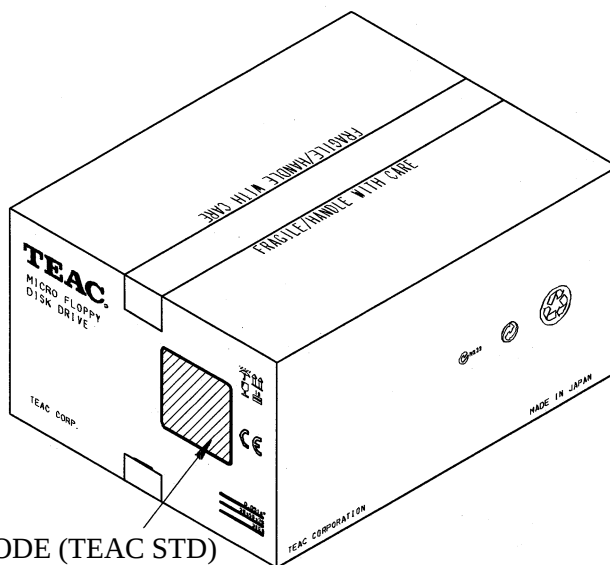
(Fig. 10.3-2) Contents of the label symbols

10.4 Exploded View of Package



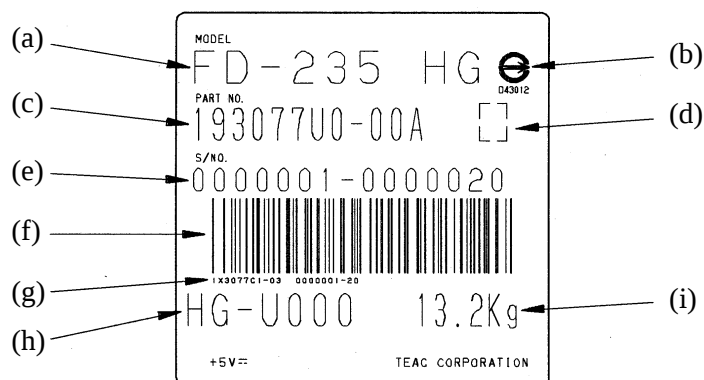
(Fig. 10.4-1) Exploded view of the package

10.5 LABEL BARCODE (TEAC STD)



(6) LABEL, BARCODE (TEAC STD)
Attaching on the both sides

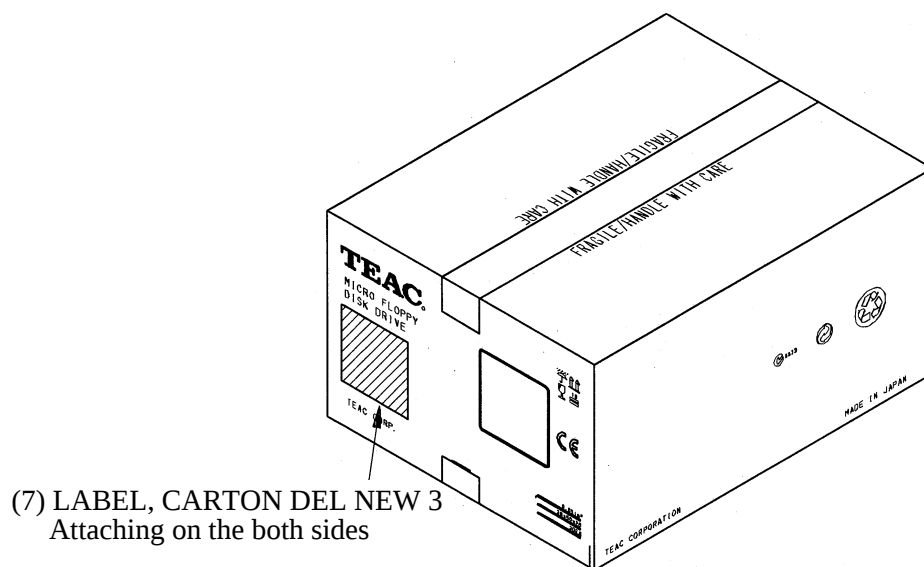
(Fig. 10.5-1) Label attaching position



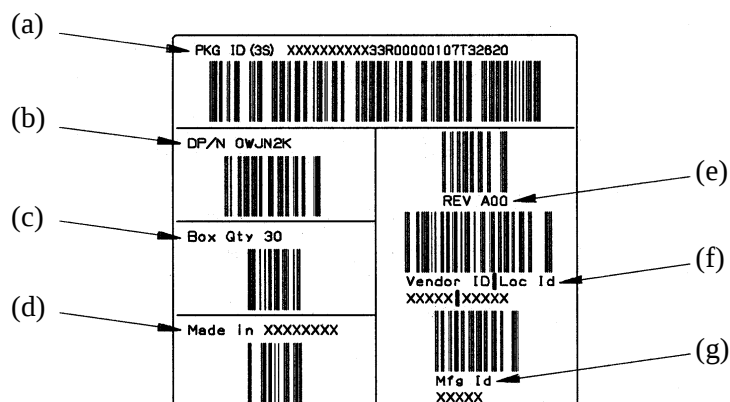
- (a) Model name
- (b) BSMI mark and number
- (c) Product part number
- (d) Packing box marking issue
- (e) Serial number of the packed product
- (f) Barcode data
- (g) Barcode content indication
- (h) Product version
- (i) Total weight of packaging

(Fig. 10.5-2) Contents of the label symbols

10.6 LABEL CARTON DEL NEW 3



(Fig. 10.6-1) Label attaching position



- (a) Package ID
- (b) DELL parts number
- (c) Box quantity
- (d) Country of origin
- (e) Drive revision
- (f) Vendor ID/Location ID
- (g) Manufacturing ID

(Fig. 10.6-2) Contents of the label symbols